Appendix I. Population Projections and Trip Forecasts with Bridge

This appendix describes the approach used for estimating future vehicle and person trips that may occur annually between South Naknek and Naknek, and South Naknek and King Salmon with the bridge alternative.

A bridge across the Naknek River will provide road access to South Naknek and, compared to the existing situation of trips by aircraft and small boats across the river, increase the number of trips that residents of South Naknek make between Naknek and King Salmon, and the number of trips that residents of the latter two communities make to South Naknek.

Even after construction of this bridge crossing, the three communities will be isolated from other road systems in Alaska. The airport at King Salmon will provide the primary mode for passenger travel to and from other communities in the state and the Lower 48 states, and tugs and barges will be the primary mode for fuel and freight to and from the three communities. A bridge alternative will, however, increase the interaction between the communities by reducing the current cost of travel, whether expressed in terms of dollars (e.g., airfare between King Salmon and South Naknek), or time (e.g., boat crossing between Naknek and South Naknek).

The current number of trips between South Naknek and the other two communities in the Bristol Bay Borough is not well documented. Some limited information is available on air transport passenger and freight volumes, but data on travel by skiff, landing craft, tug and barge, automobile, or snowmachine across the river is nonexistent. As a result, there is no obvious means to estimate future trips from the existing information on inter-community travel.

Estimating Travel Demand with Limited Information

There are other communities around the state that are also isolated from connections to the national road system, where each community has an airport or air access (via floatplanes), and where there are road links between two or more of the communities. It was hypothesized that these types of communities have analogous situations where existing travel data could be used to project future travel between South Naknek and the other two Bristol Bay Borough communities once a bridge alternative is in place. Five relevant community-pairs were identified from around the state with annual average daily traffic count information. These community-pairs included:

Naknek – King Salmon	Klawock – Thorne Bay
Seldovia – Jakolof Bay	Nome – Teller
Craig – Klawock	

A concept often used in projecting vehicle trips and other forms of interactions between communities is the "gravity model." Basically, the concept states that the number of interactions between the communities (e.g., vehicle trips or telephone calls) is a function of the level of attractiveness between the two communities (some factors may be negative and others may be positive), and the cost of that interaction. The size of the communities in terms

of population or some other measure is often used as an indicator of attractiveness, and the cost of the interaction can be measured by a number of factors such has distance between the communities, the cost of vehicle travel between the communities, or the cost of a phone call. This basic approach is used in the following analysis to estimate future trips between the three Bristol Bay Borough communities, based on an equation developed from the five community-pairs.

Data for Community-pairs

Table 1 shows the sum of population estimates for each community-pair, the average annual daily traffic (AADT) counts between each community-pair, and the mileage between each community-pair.[1] Population data are from estimates by the Alaska Department of Labor and Workforce Development for the respective years of AADT information. AADT estimates are taken from the Annual Traffic Volume reports prepared by the Central Region and Northern Region of the Alaska Department of Transportation and Public Facilities (ADOT&PF) for community-pairs in the respective regions. AADT estimates for the Southeast Region community-pairs (Craig and Klawock, Klawock and Thorne Bay) are taken from the Traffic Volume maps available on the ADOT&PF website (Accessed on August 27 and September 8, 2003). The AADT counts were selected for a road segment near a mid-point between the community pairs with a goal of minimizing influence of local community travel on the traffic counts. Mileage estimates for the Northern and Central Regions are taken from the Annual Traffic Volume reports, while estimates for the Southeast community-pairs are based on the *Alaska Milepost*.

Table 1. Community-pair Data

Community Pairs	Sum of Population	Travel Distance (miles)	Annual Average Daily Traffic
King Salmon –	1,141	15.5	570
Seldovia – Jakolof	321	11.8	80
Nome – Teller	3,830	72.2	50
Craig – Klawock	2,075	6.5	1,060
Klawock – Thorne	1,351	35.1	328

Analysis

A multiple regression analysis using SPSS (Statistical Package for the Social Sciences) was employed to estimate AADT based on the population of the community-pair, the distance between them, and since the Nome-Teller road is only maintained on a seasonal basis, a variable to account for seasonal availability.[2] For the calculation, travel distance was

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[1] There are differences in the latest year in which various data are available (e.g., population data may be 2002 but traffic data may be 2001), so the earliest year for data availability (2001 in this example) is used in the analysis.

[2] The equation derived from this analysis is:

AADT = -1,379.607 + (0.898 * Sum of Population) – (76.247 * Travel Cost) – (1,450.664 * Year-round Maintenance (1=yes, 0=no))

converted to cost based on the Internal Revenue Service reimbursable cost for mileage of $0.365 per mile. The population, travel cost, and year-round maintenance data for each community pair can be substituted into the equation and used to develop an estimate of the AADT that exists between the community pair.

Comparison of Actual Traffic Levels with Estimated Traffic Levels

The following table compares the actual AADT for the five community pairs with the estimated AADT from the equation, and the estimated AADT for trips between South Naknek and the other two communities using the equation.

Table 2. Actual and Estimated Average Annual Daily Traffic

Community Pairs	AADT	Estimated AADT
King Salmon – Naknek	570	670
Seldovia – Jakolof Bay	80	30
Nome – Teller	50	50
Craig – Klawock	2,060	2,030
Klawock – Thorne Bay	328	310
South Naknek – King Salmon[3]		90
South Naknek – Naknek		490

A comparison of the actual AADT data with the estimated AADTs suggests that the equation may be an acceptable means for estimating future trips with a bridge alternative. The equation indicates that about 580 (90 plus 490) daily passenger vehicle trips might occur if a bridge were available between South Naknek and the other two communities at present.

The estimated AADT in Table 2 do not include any possible changes in economic conditions or population changes in South Naknek that might occur with a bridge. Such changes are addressed later in the memo. Table 2 shows the number of vehicle trips that would be expected if a bridge were in place with current economic conditions and population levels.

R^2 = .995 (The R^2 indicates a strong correlation between the independent variables in the equation and the dependent variable of AADT.)

t statistic: Constant = –2.615; Population = 11.790; Travel Cost = –5.210; Year-round Maintenance = 3.691 (The *t* statistic for each of the independent variables (constant, population, travel cost, and year-round maintenance) is greater than 2, which indicates that the variables are all statistically significant. Furthermore, for variables with a *t* statistic greater than 2, the larger the value of the *t* statistic (positive or negative), the stronger the influence of the variable on the results.)

The equation states that AADT is equal to a constant (-1,379.607) plus the sum of the population for the community pair times a coefficient of 0.898 minus travel cost (distance in miles times $0.365) times a coefficient of 76.247 minus a coefficient of 1,450.664 times 1 or 0. The constant and the coefficients are estimated by the multiple regression analysis from the community pair data.

[3] Data used to estimate AADT between South Naknek and King Salmon are population of 513 and travel cost of $5.84. Data for South Naknek and Naknek are population of 763 and travel cost of $3.47.

Changes in Population with Changes in Regional Economic Conditions and No Bridge

The level of traffic will change over time as the population changes. The population forecasts shown in Table 3 are predicated on changes in local economic conditions. The base case population forecast anticipates continuation of trends over the past 13 years. The low case would see economic conditions deteriorate and the most negative population trends experienced over the past 13 years would be expected. Conversely, the high case would see economic conditions improve and the population would increase in response to those conditions. The turnabout in economic conditions is not expected to occur immediately so the current trends of decreasing population in King Salmon and Naknek would continue until about 2010 when economic conditions would have improved enough that population growth would begin.

Table 3. Projected Population by Community Without Bridge Alternative

Community	Year							
	2000	**2001**	**2002**	**2010**	**2014**	**2019**	**2024**	**2029**
Base Case								
King Salmon	442	386	392	409	374	331	287	243
Naknek	678	663	642	722	749	784	819	853
South Naknek	137	124	121	117	109	100	91	82
Bristol Bay Borough	1,257	1,173	1,155	1,248	1,233	1,215	1,197	1,178
Low Case								
King Salmon	442	386	392	357	327	290	253	215
Naknek	678	663	642	653	652	652	651	651
South Naknek	137	124	121	106	96	83	70	57
Bristol Bay Borough	1,257	1,173	1,155	1,116	1,075	1,025	974	923
High Case								
King Salmon	442	386	392	370	393	423	456	491
Naknek	678	663	642	855	923	1,007	1,092	1,177
South Naknek	137	124	121	111	120	132	146	161
Bristol Bay Borough	1,257	1,173	1,155	1,336	1,436	1,563	1,694	1,829

Economic and Population Changes Resulting from the Bridge Alternative

The availability of a bridge would be expected to result in different economic conditions in the three communities, but particularly in South Naknek. The effect of the bridge on the communities is uncertain, so a range of outcomes is provided in this analysis (See Table 4) using the low, base, and high cases.

Under the low case, it is assumed that the positive influence of the bridge is more than offset by the magnitude of adverse change in the regional economy. The decreasing population

trends in South Naknek and King Salmon continue and population levels are as projected in Table 3.

Under the base case, former residents of South Naknek who currently reside in Naknek because of the proximity to their current jobs return to the community, and the lower transportation costs result in economic growth and additional jobs in South Naknek. The overall population levels in the Bristol Bay Borough under the base case remain the same as shown in Table 3, but there is a shift in future population growth with a greater portion of future growth occurring in South Naknek. This shift begins with construction in 2008 and continues after the bridge opens in 2010.

Under the high case, positive changes in regional economic growth result in population growth in all three communities, and additional employment in the region. The positive economic changes could be associated with restructuring of the salmon fishery, oil and gas development on the Alaska Peninsula, completion of the road to Chignik, or a combination of these and other changes. Former residents of South Naknek return to the community and a significant portion of persons migrating into the region for economic opportunity also settle in South Naknek.

Table 4. Projected Population with Bridge Alternative

| | **Year** | | | | | | | |
Community	**2000**	**2001**	**2002**	**2010**	**2014**	**2019**	**2024**	**2029**
Base Case								
King Salmon	442	386	392	409	374	331	287	243
Naknek	678	663	642	715	735	759	783	808
South Naknek	137	124	121	129	137	148	158	168
Bristol Bay Borough	1,257	1,173	1,155	1,254	1,246	1,237	1,228	1,219
Low Case								
King Salmon	442	386	392	357	327	290	253	215
Naknek	678	663	642	653	652	652	651	651
South Naknek	137	124	121	106	96	83	70	57
Bristol Bay Borough	1,257	1,173	1,155	1,116	1,075	1,025	974	923
High Case								
King Salmon	442	386	392	397	416	442	470	500
Naknek	678	663	642	855	923	1,007	1,092	1,177
South Naknek	137	124	121	133	153	178	203	227
Bristol Bay Borough	1,257	1,173	1,155	1,385	1,492	1,628	1,765	1,904

Table 5 shows the projected AADT for passenger vehicles across the proposed Naknek River Bridge between South Naknek and the other two communities in the Bristol Bay Borough during the first 20 years of operation. The projected AADT uses the population forecasts for

the communities presented above in Table 4. The other data in the equation are the same as those used to estimate AADT in Table 2.

Table 5. Projected Average Annual Daily Traffic Across a Naknek River Bridge

	Year				
Scenario	**2010**	**2014**	**2019**	**2024**	**2029**
Base Case	674	675	676	677	679
Low Case	530	484	427	369	312
High Case	796	910	1,054	1,200	1,346

The number of people traveling across the bridge can be estimated by multiplying the number of vehicle trips (AADT) by the average number of people in a vehicle (vehicle occupancy rate). An occupancy rate specific to the Naknek-King Salmon road is not available so a national average of 1.7 for all trips not in a metropolitan statistical area (Nationwide Personal Transportation Survey, 1990) was used to project the person-trip estimates shown in Table 6.

Table 6. Projected Average Annual Daily Person-trips Across a Naknek River Bridge

	Year				
Scenario	**2010**	**2014**	**2019**	**2024**	**2029**
Base Case	1,145	1,147	1,149	1,151	1,154
Low Case	901	823	725	628	531
High Case	1,353	1,547	1,792	2,039	2,288

Sensitivity Analysis

A sensitivity analysis was conducted to compare the results of the selected model with other variations of the model by excluding certain community-pairs. It was suggested that Nome-Teller and the Craig-Klawock community pairs might not be representative of the situation in the Borough and might skew the results because of the greater distance between the Nome and Teller, and the larger population base of Nome and Craig-Klawock. Table 7 shows the model estimates of AADT that might occur in 2003 if a bridge were available (from Table 2), and the results if a specific community-pair are excluded. Removing Nome-Teller results in only minor changes in the results. The results still round to the same numbers as the model specified in Table 2. Removing Craig-Klawock results in a higher number of trips between South Naknek and King Salmon and a lower number of trips between South Naknek and Naknek. This latter equation suggests the total number of trips over the Naknek River would be about 20 less per day than the selected equation. These comparisons indicate that the multiple regression analysis model is robust. By providing similar estimates even when

different sets of community-pairs are employed in the analysis, the results suggest that this approach provides reliable estimates of vehicle traffic.

Table 7. Comparison of Model Results with Other Community-pairs

Community-pairs	South Naknek to/from:		Total
	King Salmon	**Naknek**	**Total**
All	90	490	580
Exclude:			
Craig-Klawock	130	430	560
Nome-Teller	90	490	580

Note: Both community-pairs cannot be excluded at the same time because the number of data points has to be larger than the number of variables in the equation.